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Peripheral pressure wire measurement of the below-the knee arteries in critical limb ischemia: validation with angiography and Laser Doppler measurements

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BACKGROUND The aim of the study was to assess the correlation between non-invasively versus invasively measured parameters by pressure wire during rest and after maximal hyperemia (peripheral fractional flow reserve (pFFR)) before and after below-the-knee angioplasty.

METHODS We have enrolled 31 patients in a prospective study with below-the-knee stenosis in critical limb ischemia. Inclusion criteria were: chronic critical limb ischemia (Rutherford 4-6), angiographically proven significant lesion of the distal lower limb (DS > 69%). Exclusion criteria were chronic total occlusion to the wound that makes pFFR measurement impossible or unacceptably risky, diabetic foot syndrome and non-viable distal lower limb. Routine quantitative angiography, pressure wire (pressure gradient, resting and stress FFR), laser Doppler (Perfusion unit (DPU), transcutaneous oxygen (TcO2)) and duplex ultrasound measurements were performed before and after angioplasty. The intervention was done by routine angiographic guidance.

RESULTS The intervention was performed with good angiographic result in all patients. Diameter stenosis improved from 85.3 ± 14.8 % to 17.1 ± 12.9 % ($p<0.01$). Resting systolic gradient was 51.4 ± 28.5 mm Hg before and 21.3 ± 17.9 mm Hg after intervention ($p<0.01$). Rest FFR improved from 0.7 ± 0.2 to 0.9± 0.1 ($p<0.01$). pFFR improved from 0.56 ± 0.2 to 0.74 ± 0.1 ($p<0.01$). Resting and stress Doppler perfusion units before the intervention were 28.2 ± 17.5 at rest and 136.1 ± 76.2 after provocation and 28.9 ± 18.8 (p=ns.) at rest and 160.1 ± 86.1 ($p<0.05$.) after intervention. The percentage change in DPU improved from 510.6 ± 424.5 to 652.1 ± 572.5 ($p<0.05$). Resting and stress TcO2 before intervention was 28 ± 17.8 and 99 ± 99.6 and after intervention it was 27.5 ± 14.9 (p=ns.) and 106.9 ± 105.8 ($p<0.05$). The percentage change in TcpO2 was 214.2 ±203.5 before and 237 ± 213 after intervention ($p<0.05$). Significant correlation was found between diameter stenosis, pressure gradient and pFFR values ($p<0.05$) and between Tc PU % and TcO2 percentage change and Dp, rest FFR, stress FFR ($P<0.05$). Toe pressures also correlated significantly with distal invasive pressures. The limb survival at one month follow up was 100%.

CONCLUSIONS Diameter stenosis, toe pressure, laser Doppler perfusion unit and TcO2 change during stress shows significant correlation with invasively assessed resting gradient and pFFR values. All invasive parameters improved after successful intervention. Further and larger patient series are necessary to clarify the real benefit of the direct pressure measurement during BTK interventions.

CATEGORIES IMAGING: FFR and Physiologic Lesion Assessment

KEYWORDS Critical limb ischemia, Fractional flow reserve

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The comparison of myocardial perfusion imaging with fractional flow reserve to detect ischemic territory for patients with multi-vessel disease

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BACKGROUND The role of myocardial perfusion imaging (MPI) in patients with multi-vessel disease is uncertain because the accuracy of MPI to identify myocardial ischemia is limited in the multi-vessel settings. The aim of this study was to assess the ability of stress MPI to detect myocardial ischemia in patients with multi-vessel disease from two different points of view: 1) MPI for revascularization decision-making, and 2) MPI for screening ischemia-positive patients.

METHODS We analyzed 102 patients with angiographically multivessel disease who underwent both stress MPI and three vessel FFR measurements to evaluate the accuracy of stress MPI in identifying myocardial ischemia using FFR < 0.75 as the gold standard. We tested 1) whether MPI findings were completely concordant with FFR in every perfusion territory (complete concordance investigation for revascularization decision-making), and 2) whether MPI could identify a patient with any FFR positive lesions (partial concordance investigation for screening ischemia-positive lesions).

RESULTS There was a poor concordance between MPI and FFR in the complete concordance investigation ($\kappa = 0.153$, $p = 0.054$) with 53% accuracy, while there was a good concordance between MPI and FFR in the partial concordance investigation ($\kappa = 0.658$, $p < 0.001$) with 84% accuracy.

CONCLUSIONS MPI often failed to identify all perfusion territory with myocardial ischemia in patients with multi-vessel disease, whereas it could identify a patient with myocardial ischemia with high accuracy even in multi-vessel settings. These results suggested that MPI was inappropriate in deciding which lesion should be treated, but could be a good help in deciding which patient should be delivered to further diagnostic test.

CATEGORIES IMAGING: FFR and Physiologic Lesion Assessment

KEYWORDS Fractional flow reserve, Multivessel disease, SPECT

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Effects of Dobutamine and Glyceryl Trinitrate on coronary blood flow and the coronary wave intensity profile

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BACKGROUND Coronary blood flow (CBF) is uniquely dependent upon central aortic blood pressure (CBP) and myocardial microvascular resistance but the underlying mechanisms are ill-defined. Coronary wave intensity (CWI) permits aortic and myocardial forces acting on CBF to be resolved. CWI has identified two major accelerative waves - the systolic forward travelling compression wave (sFCW) generated by aortic pressure rise and the diastolic backward travelling expansion wave (dBEW) attributed to the suction effect induced by diastolic microvascular recoil. The systolic backward travelling compression wave (sBCW) generated by myocardial microvascular compression during systole coincides with the sFCW and attenuates its effects on CBF. The effects of varying ventricular contractility, heart rate and blood pressure on the CWI profile are unknown.

METHODS Intracoronary pressure and CBF velocity waveforms were acquired in 21 patients with near normal (<20% luminal stenosis) epicardial coronary arteries. A dual pressure and Doppler flow velocity transducer tipped coronary guidewire was positioned in the proximal left anterior descending coronary artery. Intraventricular pressure measurements were also obtained to enable calculation of the time constant of isovolumic pressure decline (tau) and the maximal rate of systolic pressure increase (dP/dT). Measurements were taken at rest, with dobutamine 10 μg/kg/min or sublingual GTN 400mcg. CWI profiles were generated and cumulative intensities of the sFCW, dBEW and sBCW calculated.

RESULTS Heart rate, diastolic blood pressure and maximum left ventricular (dP/dT) increased with dobutamine whilst tau decreased (see Table). CBF increased with dobutamine and decreased with GTN. The cumulative intensity of all three waves increased with dobutamine and either decreased or remained stable following GTN. Dobutamine resulted in increased sFCW cumulative intensity but this increase was counterbalanced by increased sBCW intensity, thereby attenuating any change in systolic flow. The cumulative intensity of the dBEW also increased with dobutamine and this primarily accounted for increased CBF. Conversely, GTN resulted in significantly decreased systolic blood pressure, CBF and cumulative intensity of the sFCW with a trend to decrease for sBCW and dBEW intensity.